

MATERIAL SAFETY DATA SHEET

SRM Supplier: National Institute of Standards and Technology
Standard Reference Materials Program
Bldg. 202 Rm. 211
Gaithersburg, Maryland 20899

SRM Number: 3162a
MSDS Number: 3162a
SRM Name: Titanium Standard Solution
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SECTION I. MATERIAL IDENTIFICATION

Material Name: Titanium Standard Solution

Description: SRM 3162a is a 50 mL single element solution prepared gravimetrically to contain a nominal 10 mg/g of titanium with an approximate nitric acid and hydrofluoric acid volume fraction of 10 % and 2 %, respectively.

Other Designations: **Titanium in Nitric Acid** (aqua fortis; hydrogen nitrate; azotic acid; engravers acid); **Titanium tetrafluoride** (titanium IV fluoride) in **Standard Solution**

| Name | Chemical Formulas | CAS Registration Numbers |
|------------------------|-------------------|--------------------------|
| Nitric Acid | HNO ₃ | 7697-37-2 |
| Hydrofluoric Acid | HF | 7664-39-3 |
| Titanium | Ti | 7440-32-6 |
| Titanium Tetrafluoride | TiF ₄ | 7783-63-3 |

DOT Classification: Corrosive Liquid, Toxic
N.O.S. (Nitric Acid and Hydrofluoric Acid), UN2922

Manufacturer/Supplier: Available from a number of suppliers

* The addition of titanium to hydrofluoric acid, along with other intermediate chemical reactions, forms titanium tetrafluoride which will precipitate upon evaporation or drying of the sample.

SECTION II. HAZARDOUS INGREDIENTS

| Hazardous Components | Nominal Concentration (%) | Exposure Limits and Toxicity Data |
|----------------------|---------------------------|--|
| Nitric Acid | 10 | ACGIH TLV-TWA: 2 mg/kg or 5 mg/m ³ |
| | | OSHA TLV-TWA: 2 mg/kg or 5 mg/m ³ |
| | | Human, Oral: LD _{LO} : 430 mg/kg |
| Hydrofluoric Acid | 2 | ACGIH TLV-TWA: 3 mg/kg or 2.5 mg/m ³ |
| | | OSHA TLV-TWA: 3 mg/kg |
| | | Man, Inhalation: TC _{LO} : 100 mg/m ³ /1 min |
| | | Man, Oral: TD _{LO} : 143 mg/kg |
| | | Human, Inhalation: LC _{LO} : 50 mg/kg/30 min |
| Titanium | 1 | No TLV-TWA established |

SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

| Nitric Acid | Hydrofluoric Acid | Titanium |
|---|---|--|
| Appearance and Odor: A colorless to slightly yellow liquid that darkens to a brownish color upon aging and exposure to light; irritating, pungent odor | Appearance and Odor: A colorless, fuming liquid; irritating, pungent odor. | Appearance and Odor: A silvery-white or dark gray solid; odorless |
| Relative Molecular Mass: 63.01 | Relative Molecular Mass: 20.01 | Relative Atomic Mass: 47.88 |
| Density: 1.0543 (10 % nitric acid) | Density: 0.987 to 0.991 | Density: 4.5 |
| Solubility in Water: Soluble | Solubility in Water: Soluble | Solubility in Water: Insoluble |
| Solvent Solubility: Decomposes in alcohol | Solvent Solubility: Soluble in alcohol, benzene, toluene, and <i>m</i> -xylene | Solvent Solubility: Soluble in dilute acids |

NOTE: Physical and chemical data for this titanium/hydrofluoric acid/nitric acid solution do not exist. The physical and chemical data provided are for the pure components. The actual behavior of the solution may differ from the individual components.

SECTION IV. FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Method Used: N/A

Autoignition Temperature: N/A

Flammability Limits in Air (Volume %): **UPPER:** N/A

LOWER: N/A

Unusual Fire and Explosion Hazards: Although nitric acid does not burn, it is a powerful oxidizing agent that can react with combustible materials to cause fires. Hydrofluoric acid is a negligible fire hazard when exposed to heat and/or flames. Hydrofluoric acid may ignite or explode on contact with combustible materials.

Extinguishing Media: Use extinguishing media that is appropriate to the surrounding fire. Use a water spray to dilute nitric acid and hydrofluoric acid and to absorb liberated oxides of nitrogen.

Special Fire Procedures: Fire fighters should wear a self-contained breathing apparatus (SCBA) with a full face piece in the pressure demand or positive mode and other protective clothing.

SECTION V. REACTIVITY DATA

Stability: **X** **Stable** _____ **Unstable**

Conditions to Avoid: Avoid contact with combustible and other incompatible materials.

Incompatibility (Materials to Avoid): Keep nitric acid away from organic materials, plastics, rubber, and some forms of coatings. Nitric acid is incompatible with chlorine and metal ferrocyanide and ferrocyanide. Avoid contact with acids, bases, amines, halogens, halocarbons, cyanides, metals, metal oxides, metal salts, oxidizing materials, and reducing agents.

See Section IV: *Unusual Fire and Explosion Hazards*.

Hazardous Decomposition or Byproducts: Hazardous decomposition of nitric acid can produce various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO₂), nitrous oxide (N₂O), as well as nitric acid mist or vapor. Thermal decomposition of hydrofluoric acid may release halogenated (fluorinated) compounds. Thermal decomposition of titanium and titanium fluoride may release toxic and/or hazardous gases.

Hazardous Polymerization: _____ **Will Occur** **X** **Will Not Occur**

SECTION VI. HEALTH HAZARD DATA

Route of Entry: X **Inhalation** X **Skin** X **Ingestion**

Health Hazards (Acute and Chronic): Nitric Acid: Nitric acid may be fatal if inhaled, swallowed, or absorbed through skin. This material causes burns and is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Inhalation may be fatal as a result of spasm, inflammation, and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting.

Hydrofluoric Acid: Hydrofluoric acid may be fatal if inhaled, swallowed, or absorbed through skin. This material causes burns and is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Inhalation may be fatal as a result of spasm, inflammation, and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Repeated exposure to low concentrations may cause nasal congestion, nosebleeds, sinus problems, and bronchitis.

Direct eye contact with hydrofluoric acid may range from mild irritation to corneal burns. If the solution is not promptly removed, permanent visual defects and blindness may result. Hydrofluoric acid burns are characterized by blanched appearance of the skin with persistent excruciating pain. Both the liquid and the vapor can cause severe burns that may not be immediately painful or visible. Solutions less than 2 % may cause burns. The full extent of tissue damage may not exhibit itself for 12 to 24 hours after exposure. Hydrogen fluoride will penetrate the skin and attack the underlying tissues and bone. Profound hypocalcemia can occur, sometimes with fatal results. Chronic effects: causes changes in bones and joints in humans.

Titanium: Titanium may be harmful by inhalation, ingestion, or skin absorption. Exposure may cause irritation of the skin and eyes. Inhalation of titanium dusts causes irritation of the respiratory tract, tightness and pain in the chest, coughing, and difficulty breathing.

Medical Conditions Generally Aggravated by Exposure: Nitric acid may affect eye disorders, respiratory disorders, skin disorders, and allergies. Hydrofluoric acid may affect bone, joint, or tooth disorders, kidney disorders, and respiratory disorders.

Listed as a Carcinogen/Potential Carcinogen:

| | Yes | No |
|--|-------------------|-------------------|
| In the National Toxicology Program (NTP) Report on Carcinogens | <u> X </u> | <u> </u> |
| In the International Agency for Research on Cancer (IARC) Monographs | <u> </u> | <u> X </u> |
| By the Occupational Safety and Health Administration (OSHA) | <u> </u> | <u> X </u> |

EMERGENCY AND FIRST AID PROCEDURES :

Skin Contact: Remove contaminated shoes and clothing. Rinse affected area with large amounts of water followed by washing the area with soap and water. Watch for chemical irritations and treat them accordingly. Obtain medical assistance.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 min. Obtain medical assistance.

Inhalation: If inhaled, move the victim to fresh air. If breathing is difficult, give oxygen; if the victim is not breathing, give artificial respiration. Obtain medical assistance if necessary.

Ingestion: If ingestion occurs, wash out mouth with water. **DO NOT** induce vomiting. Obtain medical assistance immediately.

TARGET ORGAN(S) OF ATTACK: **Nitric Acid:** Skin, teeth, eyes, and upper respiratory tract (URT)
 Hydrofluoric Acid: Skin and Skeletal System
 Titanium: URT (causes bronchitis)

SECTION VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material Is Released or Spilled: Notify safety personnel of spills. Surfaces contaminated with spills should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Waste Disposal: Follow all federal, state, and local laws governing disposal.

Handling and Storage: Provide general and local explosion proof ventilation systems to maintain airborne concentrations below the TLV. Provide approved respiratory apparatus for nonroutine or emergency use. Use an approved filter and vapor respirator when the vapor or mist concentrations are high. Wear gloves and chemical safety glasses where contact with the liquid or high vapor concentrations may occur. An eye wash station and washing facilities should be readily available near handling and use areas. Wash exposed skin areas several times a day with soap and warm water.

NOTE: Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. **DO NOT** wear contact lenses in the laboratory.

SECTION VIII. SOURCE DATA/OTHER COMMENTS

Sources: MDL Information Systems, Inc., MSDS *Nitric Acid*, March 16, 1999.
MDL Information Systems, Inc., MSDS *Hydrogen Fluoride*, March 16, 1999.
MDL Information Systems, Inc., MSDS *Titanium*, September 10, 1998.
The Merck Index, 11th Ed., 1989.
The Sigma-Aldrich Library of Chemical Safety Data, Ed. II, 1988.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data on the MSDS. The certified value for this material is given on the NIST Certificate of Analysis.